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Surface Engineering of Chemically Exfoliated MoS2 in a "click": How to Generate Versatile Multifunctional Transition Metal Dichalcogenides-Based Platforms

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Abstract

Copyright © 2018 American Chemical Society. The interest for transition metal dichalcogenides (TMDs) as two-dimensional (2D) analogues of graphene is steadily growing along with the need of efficient and easy tunable protocols for their surface functionalization. This latter aspect holds a key role in the widespread application of TMDs in various technological fields and it represents the missing step to bridge the gap between the more popular C sp2-based networks and their inorganic counterparts. Although significant steps forward have already been made in the field of TMDs functionalization (particularly for MoS2), a rational approach to their surface engineering for the generation of 2D organic-inorganic hybrids capable to accommodate various molecules featured by orthogonal groups has not been reported yet. The paper paves the way toward a new frontier for "click" chemistry in material science. It describes the post-synthetic modification (PSM) of covalently decorated MoS2 nanosheets with phenylazido pendant arms and the successful application of CuAAC chemistry (copper-mediated azide-alkyne cycloaddition) towards the generation of highly homo- and hetero-decorated MoS2 platforms. This contribution goes beyond the proof of evidence of the chemical grafting of organic groups to the surface of exfoliated MoS2 flakes through covalent C-S bonds. It also demonstrates the versatility of the hybrid samples to undergo post-synthetic modifications thus imparting multimodality to these 2D materials. Several physico-chemical [SEM microscopy, fluorescence lifetime imaging (FLIM)], spectroscopic (IR, Raman, XPS, UV-vis), and analytical tools have been combined together for the hybrids' characterization as well as for the estimation of their functionalization loading.

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